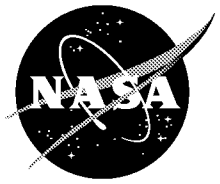
NASA/TM—2000–209891, Vol. 218



Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Sara K. Conrad, Editors

Volume 218

BOREAS TGB-1 Soil CH_4 and CO_2 Profile Data from NSA Tower Sites

Patrick Crill and Ruth K. Varner
University of New Hampshire, Durham

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

November 2000

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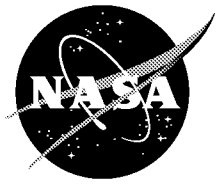

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BOREAS TGB-1 Soil CH_4 and CO_2 Profile Data from NSA Tower

Patrick M. Crill, Ruth K. Varner

Summary

The BOREAS TGB-1 team made numerous measurements of trace gas concentrations and fluxes at various NSA sites. This data set contains methane (CH_4) and carbon dioxide (CO_2) concentrations in soil profiles from the NSA-OJP, NSA-OBS, NSA-YJP, and NSA-BP sites during the period of 23-May to 20-Sep-1994. The soil gas sampling profiles of CH_4 and CO_2 were completed to quantify controls on CO_2 and CH_4 fluxes in the boreal forest. The data are provided in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS TGB-01 Soil CH_4 and CO_2 Profile Data from NSA Tower Sites

1.2 Data Set Introduction

The Trace Gas Biogeochemistry (TGB)-01 team took soil gas profiles at the BOReal Ecosystem-Atmosphere Study (BOREAS) Northern Study Area (NSA) Old Jack Pine (OJP), Young Jack Pine (YJP), Old Black Spruce (OBS), and Beaver Pond (BP) sites during the growing season of 1994. Some of the soil samplers were placed in the ground during the summer of 1993 to ensure equilibration. Portable samplers were used at sites where no permanent soil gas samplers were installed. The soil gas samples were analyzed for CO_2 and CH_4. At some of the OBS and BP sites, the soil/peat was saturated. At these sites, water samples were taken and analyzed for CH_4 and CO_2.

1.3 Objective/Purpose

Soil gas sampling profiles of CH_4 and CO_2 were completed to quantify controls on CO_2 and CH_4 fluxes in the boreal forest.

1.4 Summary of Parameters

The data contain measurements of the soil pore concentrations of CH_4 and CO_2. The data were measured at the soil surface and at different depths (5-93 cm below the surface) at the various locations. Most of the profiles correspond with collar flux measurements.

1.5 Discussion

The soil gas profiles were taken at varying depths from 0 to 93 cm below the surface, where the surface (0 cm) is designated as the top of the vegetated ground cover. At some sites, groups of samplers were permanently embedded in the ground to ensure consistency of sampling location. The OBS site was divided into two different sets of data: one with aluminum chambers, and one with plastic chambers. The OBS site where Patrick Crill (TGB-01) measured fluxes with aluminum chambers and collars had permanent samplers associated with each aluminum collar flux measurement. The OBS site where Dean Moosavi (TGB-01) measured fluxes with plastic chambers and collars had soil gas profiles taken with a portable sipper associated with each of the plastic collar flux measurements. Moosavi also measured the BP site fluxes, and the associated profiles were measured with a portable sipper. The OJP site had a nest of permanent sippers associated with each aluminum flux collar. The YJP site had only one nest of permanent sippers; therefore, it was to be associated with all aluminum collar flux measurements at that site.

1.6 Related Data Sets

BOREAS TGB-01 CO2 and CH4 Chamber Flux Data over the NSA
BOREAS TGB-03 CO2 and CH4 Chamber Flux Data over the NSA
BOREAS TGB-05 CO2 and CH4 Chamber Flux Data over the NSA

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Patrick M. Crill
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University of New Hampshire

2.2 Title of Investigation

Magnitude and Control of Trace Gas Exchange in Boreal Ecosystems

2.3 Contact Information

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3. Theory of Measurements

CH_4 and CO_2 measurements of soil pore gas and/or water can provide constraints and implications for flux controls at the surface (Crill, 1991). The profile measurements will enable the scientist to determine if the uptake/flux is occurring in a particular soil depth range.

4. Equipment

4.1 Sensor/Instrument Description

Shimadzu GC-14A, FID and TCD

CO_2 was quantified with a Shimadzu GC-14A Gas Chromatograph (GC) with a thermal conductivity detector (TCD) operated at 70 °C after separation on a HayeSepQ column at 40 °C using ultra-pure (99.999%) He as a carrier gas flowing at 30 mL/min. CH_4 was quantified with a Shimadzu GC-14A or a Shimadzu GC-MINI2 with a flame ionization detector (FID) operated at 125 °C after separation on a HayeSepQ column at 40 °C using ultra-pure (99.999%) N_2 as a carrier gas flowing at 30 mL/min. Analog signals (0-1 V) from the detectors were digitized at 10 Hertz (Hz) with a Hewlett Packard (HP) 35000D A/D board and quantified and logged using HP ChemStation software.

4.1.1 Collection Environment

Samples were collected under ambient conditions.

4.1.2 Source/Platform

Soil and water.

4.1.3 Source/Platform Mission Objectives

The mission objective was to quantify the CO_2 and CH_4 soil profile concentrations present in the boreal forest NSA.

4.1.4 Key Variables

CH_4 and CO_2 concentrations were the key variables measured at different depths in the soil or peat profile.

4.1.5 Principles of Operation

The Shimadzu GC-14A is equipped with a hydrogen FID and a TCD. The FID is used to measure CH_4, while the TCD is used to quantify CO_2. The FID uses a hydrogen flame in an air atmosphere to burn components as they exit the column. In the flame, carbon-carbon bonds are fragmented so that various organic ions and free electrons exist. Application of a voltage across a collector electrode over the flame causes an ion current to flow, which is amplified and then measured as the output signal. The TCD elutes CO_2 by flowing a sample in a helium carrier gas past metallic filaments with current flowing through them. The sample components with lower thermal conductivity than the helium carrier gas raise the filament temperature when they pass through. The signal output from the TCD is a measurement of the change in filament resistance caused by the temperature rise. The signal output from both the FID and TCD is for a data processor, integrator, recorder, or computer (Instruction Manual: GC-14A; Shimadzu Corporation, Kyoto, Japan). The GC-MINI2 was equipped with a FID and operated in the same manner as the GC-14A FID.

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument

Manufacturer of GC-14A FID/TCD and GC-MINI2
Shimadzu Scientific Instruments, Inc.
7102 Riverwood Drive
Columbia, MD 21046
(410) 381-1227

The investigator manufactured the samplers.

4.2 Calibration

Signal peaks from the detectors were quantified with working standards calibrated against Canadian AES (Canadian Atmospheric Environment Services) certified primary standards acquired by the BOREAS project and a CO_2/ CH_4 standard of Niwot Ridge air prepared by National Oceans and Atmospheric Administration (NOAA) Climate Monitoring and Diagnostics Laboratory (CMDL).

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

The sensitivity of the TCD is approximately 6,000 mV mL/mg. The FID's maximum sensitivity is 3×10^{-12} grams/second for diphenyl.

4.2.2 Frequency of Calibration

The instrument was calibrated on a daily basis. Standards were run generally before and after samples on a given day of analysis.

4.2.3 Other Calibration Information

Signal peaks from the detectors were quantified with working standard calibrated against Canadian Atmospheric Environment Services (AES) certified primary standards acquired by the BOREAS project and a CO_2/CH_4 standard of Niwot Ridge air prepared by the National Oceanic and Atmospheric Administration (NOAA) Climate Monitoring and Diagnostics Laboratory (CMDL).

5. Data Acquisition Methods

Soil profile samples were taken from different depths at the YJP, OJP lichen and moss, and OBS (Patrick Crill) sites with soil gas samplers (sippers) installed in August 1993. The sippers are fabricated from 50 cm of high-efficiency stainless steel 1/8-inch tubing with small holes drilled along the last 10 cm. A hole was dug in the ground, and the stainless steel tubing was placed horizontally in the soil profile. Polypropylene tubing attached the steel tubing to the surface, and allowed for sampling. The polypropylene tubing was fitted with a polycarbonate/nylon stopcock at the surface. Soil air was sampled using the polycarbonate/nylon stopcock and 60-mL polypropylene syringes. A portable soil gas sipper was used at the OBS (Dean Moosavi), BP, and OJP sites. It was constructed with the same materials as the installed sippers. Prior to sampling, 10 mL of soil air was discarded to avoid contamination from ambient air. After discarding the initial 10 mL of soil air, a 30-mL soil air sample was taken. The syringes were fitted with rubber bands to prevent any leaking in of ambient air and were transported to the lab for analysis on the GC-14A FID/TCD and/or the MINI-2 FID.

In some cases when the soil/peat was saturated, the samples were taken as water samples. Prior to sampling, 10 mL of soil pore water was discarded to avoid contamination from ambient air. After the initial 10 mL of soil pore water was discarded, a 30-mL soil pore water sample was taken. In the lab, the syringes were filled to 60 mL with ultra-high-purity nitrogen. The syringes were shaken for 2 minutes to allow the dissolved CH_4 and CO_2 to enter the air space. This method is described by McAuliffe, 1971. The air in the syringe was then removed from the 60-mL syringe with a 10-mL glass syringe and run on the GC-14A FID/TCD and/or the MINI-2 FID.

6. Observations

6.1 Data Notes

No major problems with GC.

6.2 Field Notes

For the soil profiles completed with the aluminum chamber fluxes (Patrick Crill):

- 20Jun94 - OBS, soil profile at collars OBS 5 and OBS 6; couldn't draw the 30-cm sample.
- 27Jun94 - OBS, soil profile at collars OBS 5 and OBS 6; couldn't draw the 30-cm or 25-cm samples.
- 04Jul94 - Figured out that there is permafrost at collars OBS 5 and OBS 6 at 25-30 cm.
- 04Jul94 - No 30-cm sample at collars OBS 7 and OBS 8.
- 04Jul94 - No 30-cm sample at collars OBS 9 and OBS 10.
- 10Jul94 - No 30-cm sample at YJP; too rocky.
- 16Jul94 - No 25- or 30-cm samples at YJP; too rocky.
- 20Jul94 - Permafrost at OBS collar 5 at 25 and 30 cm; permafrost at OBS collar 9 at 20, 25, and 30 cm.
- 23Jul94 - No profile samples for YJP 3.
- 26Jul94 - OBS 5 has permafrost below 15-cm; no 20-, 25-, or 30-cm samples.
- 30Jul94 - No profile samples at YJP 1 or YJP 3.
- 01Aug94 - OBS 5 still has permafrost below 20 cm.
- 07Aug94 - No profile samples after 15 cm at YJP 1; no profile samples for YJP 3.
- 08Aug94 - OBS 5 has permafrost below 25 cm.
- 14Aug94 - All profiles complete from OBS; no permafrost at 5 anymore!
- 30Aug94 - OBS 5 and OBS 6 show water at 20 cm in soil profile.
- 30Aug94 - OBS 9 and OBS 10 show water at 30 cm in soil profile.

For the soil profiles completed with the plastic chamber fluxes (Dean Moosavi):

- 16May94 - OJP moss site profile frozen at 13- and 24-cm depths.
- 19May94 - BP profiles: collar 19 frozen below 25 cm; collar 21 frozen below 10 cm; collar 27 frozen below 20 cm.
- 20May94 - OBS collar 6 frozen below 10 cm; OBS collar 8 frozen below 20 cm.
- 22May94 - OJP moss profile frozen at 13 and 24 cm.
- 25May94 - OBS collar 9 frozen below 15 cm; OBS collar 8 frozen below 25 cm; OBS collar 6 frozen below 15 cm; OBS collar 1 profile frozen below 20 cm.
- 26May94 - BP collar 22 frozen below 10 cm; BP collar 19 frozen below 10 cm; the pond and mire sites had water at the surface, so the entire profiles were water samples.
- 27May94 - OBS lichen site profile frozen below 15 cm; OBS water site profile frozen below 15 cm; OBS coast profile frozen below 15 cm; OBS collars 13-16 were water profiles.
- 31May94 - BP lichen profile frozen below 15 cm; the pond and mire sites had water at the surface, so the entire profiles were water samples.
- 01Jun94 - OBS lichen profile frozen below 20 cm; OBS lichen profile frozen below 20 cm; OBS collars 13-16 profiles were water samples below 5 cm.
- 04Jun94 - OBS coast profile frozen below 20 cm; OBS water profile frozen below 25 cm.
- 08Jun94 - OBS coast profile frozen below 20 cm; OBS moss profile frozen below 25 cm; OBS lichen profile frozen below 25 cm; OBS 13-16 profiles were water samples below 5 cm.
- 10Jun94 - BP lichen profile frozen below 33 cm; BP moss profile frozen below 25 cm.
- 16Jun94 - BP collars 21-24 had water below 10 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 20Jun94 - OBS moss profile frozen below 25 cm; OBS coast profile frozen below 25 cm; OBS collars 1-4 had water below 25 cm; OBS collars 5-8 had water below 25 cm; OBS collars 9-12 had water below 30 cm; OBS collars 13-16 had water throughout the profile.
- 21Jun94 - BP lichen profile frozen below 30 cm; BP collars 21-24 had water below 10 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 28Jun94 - OBS collars 9-12 had water below 20 cm; OBS collars 13-16 had water throughout the profile.
- 30Jun94 - BP collars 25-28 had water below 10 cm; BP collars 29-32 had water below 10 cm.
- 04Jul94 - OBS collars 9-12 had water below 20 cm; OBS collars 13-16 had water throughout the profile.
- 08Jul94 - BP collars 21-24 had water below 15 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 13Jul94 - OBS collars 9-12 had water below 25 cm; OBS collars 13-16 had water throughout the profile.
- 14Jul94 - BP collars 21-24 had water below 10 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 18Jul94 - BP collars 21-24 had water below 10 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 20Jul94 - OBS collars 9-12 had water below 25 cm; OBS collars 13-16 had water throughout the profile.
- 25Jul94 - BP collars 21-24 had water below 10 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 27Jul94 - OBS collars 9-12 had water below 30 cm; OBS collars 13-16 had water throughout the profile.
- 01Aug94 - OBS collars 9-12 had water below 30 cm; OBS collars 13-16 had water throughout the profile.
- 02Aug94 - BP collars 21-24 had water below 10 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 23Aug94 - BP collars 21-24 had water below 20 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.

- 30Aug94 - OBS collars 9-12 had water below 25 cm; OBS collars 13-16 had water below 10 cm.
- 31Aug94 - BP collars 21-24 had water below 20 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 05Sep94 - BP collars 21-24 had water below 15 cm; BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.
- 06Sep94 - OBS collars 9-12 had water below 25 cm; OBS collars 13-16 had water below 10 cm.
- 12Sep94 - OBS collars 13-16 had water below 10 cm.
- 13Sep94 - BP collars 25-28 had water throughout the profile; BP collars 29-32 had water throughout the profile.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The site descriptions and North American Datum of 1983 (NAD83) coordinates are as follows.

For the data collected with the aluminum chamber fluxes (Patrick Crill):

- The OJP collars and profile sampling sites were located as follows: Moss collars were approximately northwest of the tower; the profile corral was located a few meters south of the collars (55.9287°N, 98.6248°W).
- The OJP lichen collars were due west of the tower; the profile trench was located about 1 m southeast of the collars (55.9280°N, 98.62481°W).
- The YJP collars were located southeast of the tower; the gas profile corral was located approximately 1 m west of the collars (55.9286°N, 98.62019°W).
- The OBS collars were located along a low to high moisture gradient from the lichen to the feather moss, the fen rim, and ending at the fen site. The lichen and feather moss collars were located along the boardwalk approximately 200 m northeast of the tower. The fen rim and fen site collars were located due east of the lichen and feather moss sites about 150 m and 200 m, respectively.

For the soil profile data completed with the plastic chamber fluxes (Dean Moosavi):

- The OBS collars and profile sampling sites were located as follows: The OBS sampling collars were located along a moisture gradient from feather moss and lichen sites to the fen rim site and ending with the fen sites. The transect ran approximately east to west and was located about 200 m northeast of the tower at the OBS site (55.88007°N, 55.88007°W).
- The BP collars and profile sampling sites were located as follows: The BP sampling sites were located along a low to high moisture gradient that began with the upland lichen site, then the sphagnum moss site, the mire site, and ending at the pond site. The transect runs approximately north to south and is about 60 m from the BP tower (55.8422°N, 98.02747°W).
- Global Positioning System (GPS) measurements were taken at the sampling sites but the data were not retrievable.

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

Four collars were placed in the ground for each biome type. They were approximately 1 to 2 m apart depending on the site specifics. The collar_type in Section 7.3.3 refers to the dominant vegetation in the collars.

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
Data were collected from 16-May to 20-Sep-1994.

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
The soil profiles were taken approximately every 7 days beginning 16-May-1994 and ending 13-Sep-1994.

7.3 Data Characteristics

7.3.1 Parameter/Variable
The parameters contained in the data files on the CD-ROM are:

Column Name
SITE_NAME
SUB_SITE
DATE_OBS
CH4_CONC
CO2_CONC
SOIL_DEPTH
COVER_TYPE
PROFILE_NUM
CRTFCN_CODE
REVISION_DATE

7.3.2 Variable Description/Definition
The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, or TRN; TTT identifies the cover type for the site, (999 if unknown); and CCCCC is the identifier for site (exactly what it means will vary with site type).
SUB_SITE	The identifier assigned to the subsite by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the subsite instrument (e.g., HYD06 or STAFF), and IIIII is the identifier for the subsite (often this will refer to an instrument).

DATE_OBS	The date on which the data were collected.
CH4_CONC	CH4 concentration.
CO2_CONC	CO2 concentration.
SOIL_DEPTH	The depth below the soil surface at which the measurement was taken.
COVER_TYPE	The dominant species, vegetation or type of land cover that exists at the location.
PROFILE_NUM	Where the profile measurements were taken.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are Checked by PI (CPI), Certified by Group CGR), Preliminary (PRE), and CPI but questionable (CPI-???).
REVISION_DATE	The most recent date that the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
CH4_CONC	[parts per million]
CO2_CONC	[parts per million]
SOIL_DEPTH	[millimeters]
COVER_TYPE	[none]
PROFILE_NUM	[none]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	Not Applicable
SUB_SITE	Not Applicable
DATE_OBS	Investigator
CH4_CONC	Shimadzu GC-14A, FID and TCD.
CO2_CONC	Shimadzu GC-14A, FID and TCD.
SOIL_DEPTH	Investigator
COVER_TYPE	Investigator
PROFILE_NUM	Investigator
CRTFCN_CODE	Not Applicable
REVISION_DATE	Not Applicable

7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-BVP-FLXTR	NSA-YJP-FLXTR	None	None	None	None
SUB_SITE	TGB01-SPR01	TGB01-SPR07	None	None	None	None
DATE_OBS	16-MAY-94	13-SEP-94	None	None	None	None
CH4_CONC	0	27439	-999	None	None	Blank
CO2_CONC	289.1	70790	-999	None	None	Blank
SOIL_DEPTH	0	930	None	None	None	None
COVER_TYPE	N/A	N/A	None	None	None	Blank
PROFILE_NUM	M-BP-mc25	YJP	None	None	None	None
CRTFCN_CODE	PRE	PRE	None	None	None	None
REVISION_DATE	23-AUG-96	10-JAN-97	None	None	None	None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel deemed the value to be unreliable.
Below Detect Limit -- The value that indicates parameter values below the instrument's detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.
Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BOREAS Information System (BORIS) staff combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A -- Indicates that the value is not applicable to the respective column.
None -- Indicates that no values of that sort were found in the column.

7.4 Sample Data Record

The following are wrapped versions of data records from a sample data file on the CD-ROM.

```
SITE_NAME,SUB_SITE,DATE_OBS,CH4_CONC,CO2_CONC,SOIL_DEPTH,COVER_TYPE,PROFILE_NUM,
CRTFCN_CODE,REVISION_DATE
'NSA-BVP-FLXTR','TGB01-SPR0'1,14-JUL-94,4538,40690,200,'Mire','M-BP-mc25','CPI',
10-JAN-97
'NSA-BVP-FLXTR','TGB01-SPR01',14-JUL-94,9326,46080,250,'Mire','M-BP-mc25','CPI',
10-JAN-97
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data is the CO_2 and CH_4 concentrations measured on a particular date at a particular site.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

$$R_f = C_{std}/A_{std}$$
$$C_s = R_f * A_s$$

Where: R_f = Response factor
A_{std} = Average of 10 standard peak areas
C_{std} = Concentration of the standard
C_s = Concentration of the sample
A_s = Peak area of sample

CH_4 and CO_2 concentrations were calculated from the average of 10 peak areas of known CH_4 and CO_2 standards. The response factor was calculated as the concentration of the known standard divided by the average of 10 standard peak areas. The peak area of the unknown sample was multiplied by the response factor.

9.1.1 Derivation Techniques and Algorithms

Not applicable.

9.2 Data Processing Sequence

9.2.1 Processing Steps

The peak areas were taken directly from the HP ChemStation reports from the GC. They were entered into spreadsheets, and the concentrations were calculated using the formulas in Section 9.1.1.

9.2.2 Processing Changes

Not applicable.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None given.

9.3.2 Calculated Variables
Not applicable.

9.4 Graphs and Plots
None given.

10. Errors

10.1 Sources of Error
Sampling error when pulling the syringe samples could include:

- Sampling too rapidly, causing the air/water sample to be taken from the vertical direction rather than from the depth at which the sampler was located.
- Not flushing the line before sampling , which could cause dilution of the sample with air/water from the last sampling time.
- Not completely closing the syringes or allowing them to come open during transport, causing dilution from ambient air.

Errors such as these would have been written down in the lab/field books, and those data therefore would have been edited out. The analytical precision of the GCs is 0.2% for CH_4 and 1% for CO_2.

10.2 Quality Assessment

10.2.1 Data Validation by Source
None given.

10.2.2 Confidence Level/Accuracy Judgment
None given.

10.2.3 Measurement Error for Parameters
The analytical precision of the GCs is 0.2% for CH_4 and 1% for CO_2.

10.2.4 Additional Quality Assessments
None given.

10.2.5 Data Verification by Data Center
Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data
The analytical precision of the GCs is 0.2% for CH_4 and 1% for CO_2.

11.2 Known Problems with the Data
None overall; see notes under Section 6 and Section 10.

11.3 Usage Guidance
None given.

11.4 Other Relevant Information
None given.

12. Application of the Data Set

This data set may be used in comparison with the chamber flux data to determine the controls on fluxes from these various environments.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

HP ChemStation.

14.2 Software Access

Contact Hewlett Packard.

15. Data Access

The TGB-01 soil CH_4 and CO_2 profile data from NSA tower sites are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None .

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

Instruction Manual: GC-14A. Shimadzu Corporation, Kyoto, Japan.

17.2 Journal Articles and Study Reports

Crill, P.M. 1991. Seasonal patterns of methane uptake and carbon dioxide release by a temperate woodland, Global Biogeochemical Cycles, 5 (4), 319-334.

McAuliffe, C.C. 1971. Gas chromatographic determination of solutes by multiple phase equilibration, Chem. Technol., 1, 46-51.

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

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Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None given.

19. List of Acronyms

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AES      - Atmospheric Environment Services
ASCII    - American Standard Code for Information Interchange
BOREAS   - BOReal Ecosystem-Atmosphere Study
BORIS    - BOREAS Information System
BP       - Beaver Pond
CD-ROM   - Compact Disk-Read-Only Memory
CGR      - Certified by Group
CMDL     - Climate Monitoring and Diagnostics Laboratory
CPI      - Checked by PI
CPI-???  - CPI but questionable
DAAC     - Distributed Active Archive Center
ECD      - Electron Capture Detector
EOS      - Earth Observing System
EOSDIS   - EOS Data and Information System
FID      - Flame Ionization Detector
GC       - Gas Chromatograph
GIS      - Geographic Information System
GPS      - Global Positioning System
GSFC     - Goddard Space Flight Center
HP       - Hewlett Packard
HTML     - HyperText Markup Language
NASA     - National Aeronautics and Space Administration
NOAA     - National Oceanic and Atmospheric Administration
NSA      - Northern Study Area
OBS      - Old Black Spruce
OJP      - Old Jack Pine
ORNL     - Oak Ridge National Laboratory
PANP     - Prince Albert National Park
PRE      - Preliminary
SSA      - Southern Study Area
TCD      - Thermal Conductivity Detector
TGB      - Trace Gas Biogeochemistry
URL      - Uniform Resource Locator
YJP      - Young Jack Pine
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13. ABSTRACT *(Maximum 200 words)*

The BOREAS TGB-1 team made numerous measurements of trace gas concentrations and fluxes at various NSA sites. This data set contains methane (CH_4) and carbon dioxide (CO_2) concentrations in soil profiles from the NSA-OJP, NSA-OBS, NSA-YJP, and NSA-BP sites during the period of 23-May to 20-Sep-1994. The soil gas sampling profiles of CH_4 and CO_2 were completed to quantify controls on CO_2 and CH_4 fluxes in the boreal forest. The data are provided in tabular ASCII files.

14. SUBJECT TERMS

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